Equity-Based Insurance Guarantees Conference

Nov. 11-12, 2019

Chicago, IL

Risk Management Track: How Do You Solve a Problem Like the Vega?

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2A – Risk Management Track: How Do You Solve a Problem Like the Vega?

11 November 2019, Session 2A (1330-1500 hours)
Society of Actuaries
2019 Equity-Based Insurance Guarantees Conference

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Agenda – How Do You Solve a Problem Like the Vega?

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Introduction: Volatility Risk in VA and FIA Guarantees

Volatility Risk Solutions:

1. Retain
2. Mitigate
3. Hybrid Solution

Appendix

GLWB Reinsurance Cost Index

Introduction:

Volatility Risk in VA and FIA Guarantees

Start at the Very Beginning…

Volatility Risk in VA and FIA Guarantees

Post-Financial Crisis Industry Response to Volatility Risk – Primarily Product-Driven

- Asset transfer programs
- Capped Volatility
- Target Volatility
- Capital Preservation
- VIX-indexed fees
- US Treasury-indexed

Volatility Risk in VA and FIA Guarantees

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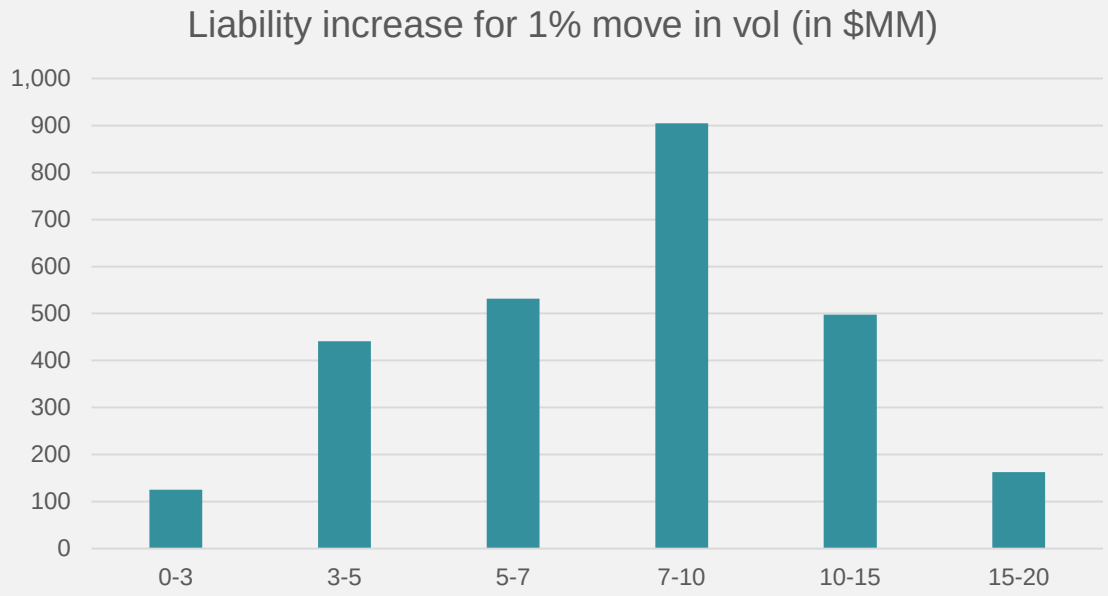
More Recent Developments – Last 2-3 Years

- Industry is walking back from product changes / de-risking
- Post-crisis period – low equity volatility, low interest rates
- Many product approaches (target vol funds, e.g.) have underperformed
- Both new and inforce VA / FIA guarantees still demand a solution to volatility risk

We will be focusing on Risk Management approaches to managing the volatility risk, rather than product de-risking.

Variable Annuities: Estimation of Total GLWB Vega

LIMRA estimates ~ $650+ Bn in GLWB assets end of Q2 2019



https://www.limra.com/globalassets/limra/research/research-benchmarks/u.s.-individual-annuity-market/u.s.-variable-annuity-sales/2019/2019_2q_va-glb-election-tracking-survey.pdf

1 Retain Volatility Risk

I have confidence…

Retain Volatility Risk

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	Hedging	Reinsurance	Accounting
Retain Volatility Risk			
Mitigate Volatility Risk			

Retain Volatility Risk – Potential Reasoning

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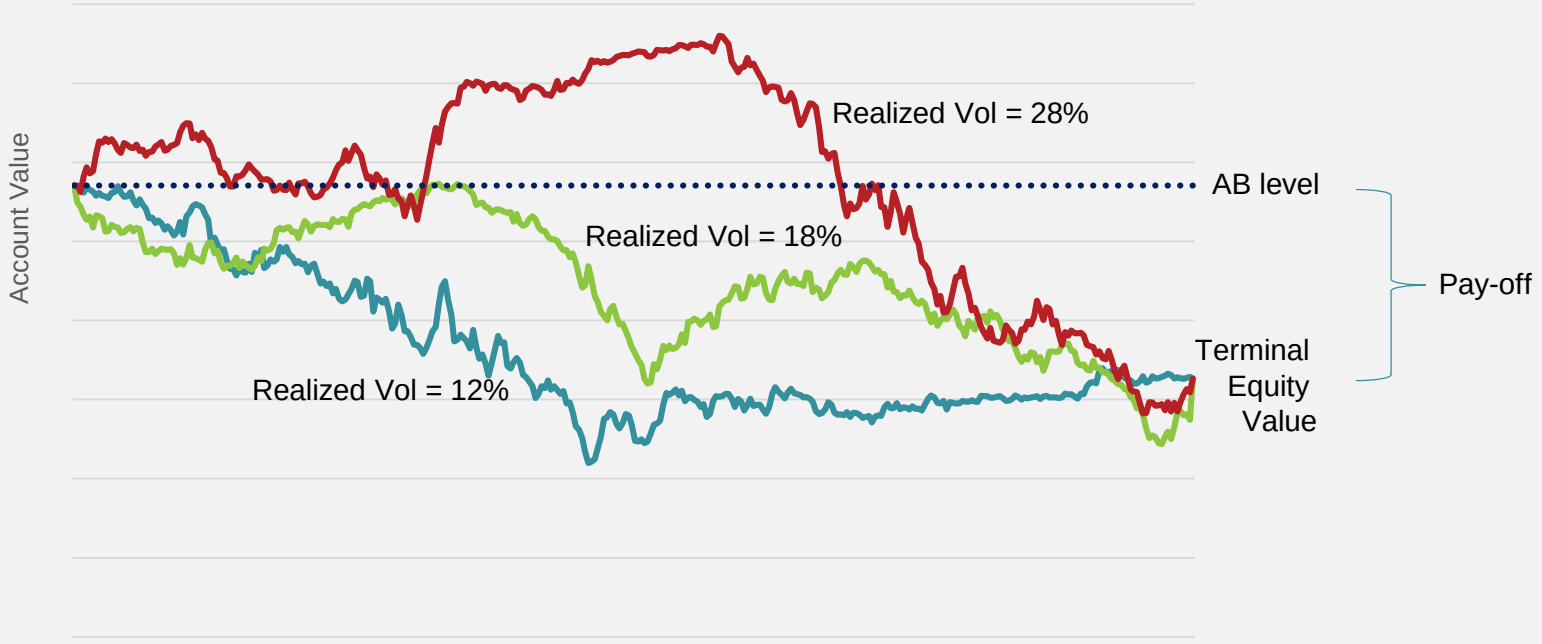
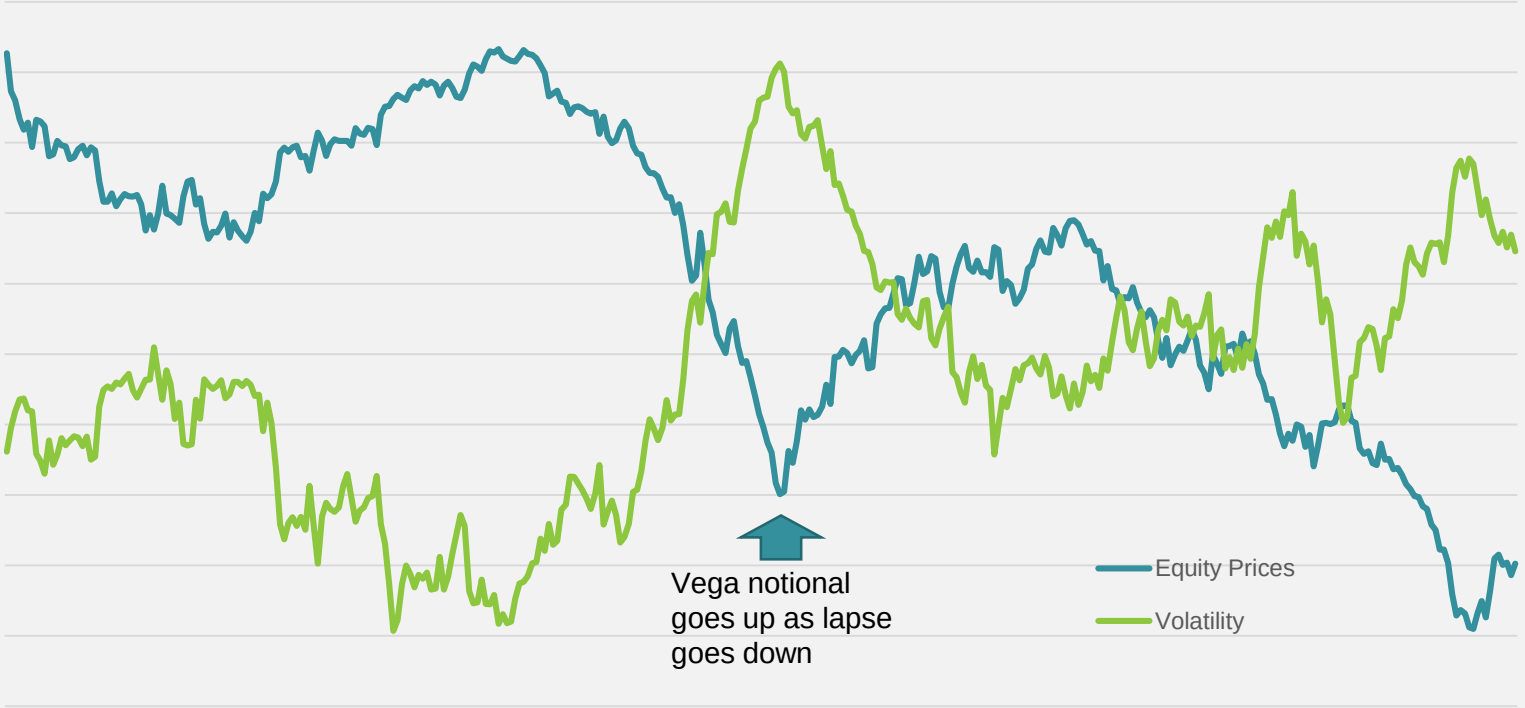
1. GMxB Cash Flows are a function of equities and rates, not volatility



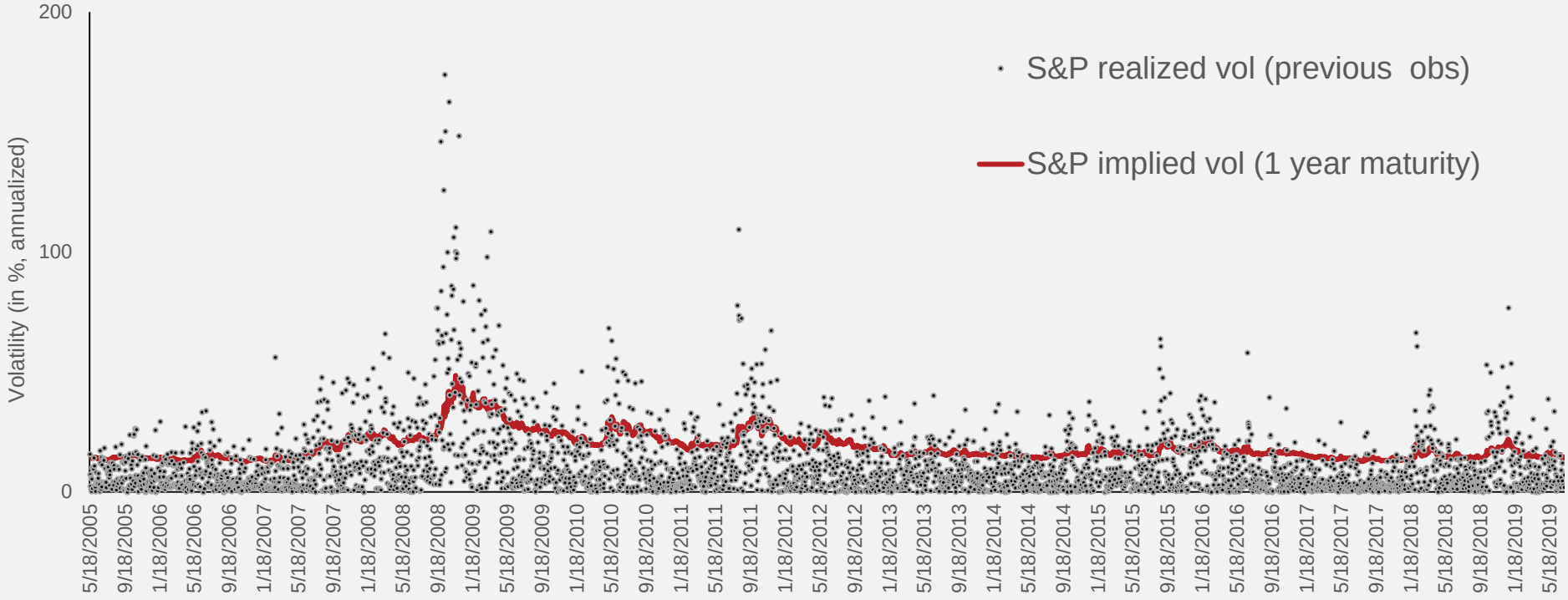
Retain Volatility Risk – Potential Reasoning

2. Negative Convexity



Retain Volatility Risk – Potential Reasoning

3. Volatility Risk Premium



(Source: Bloomberg)

Retain Volatility Risk – Hedging

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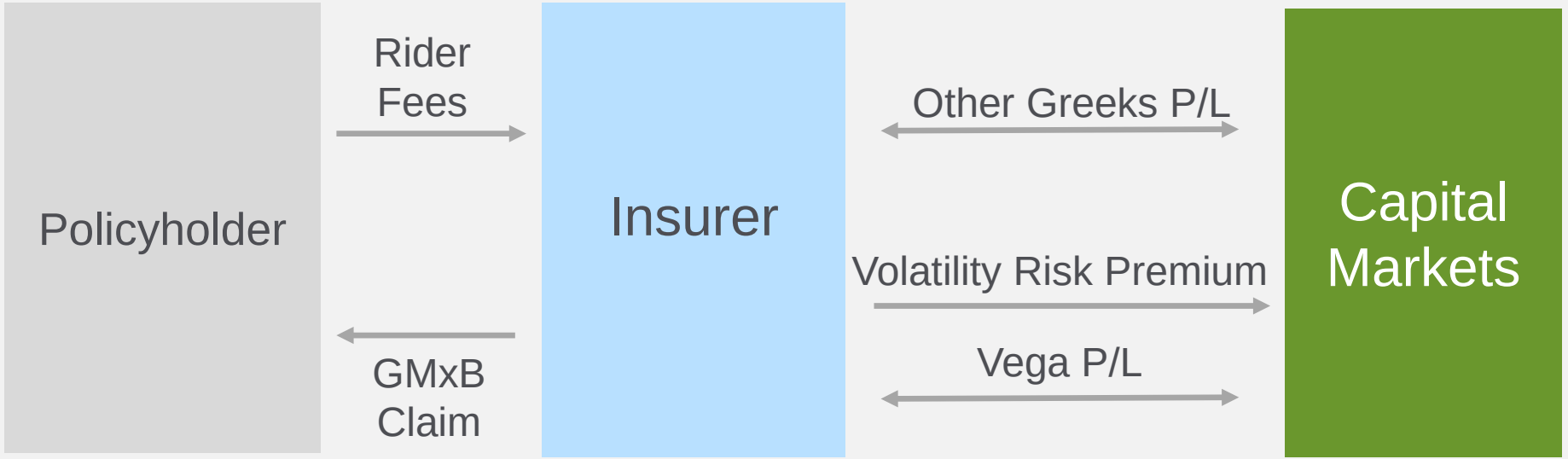
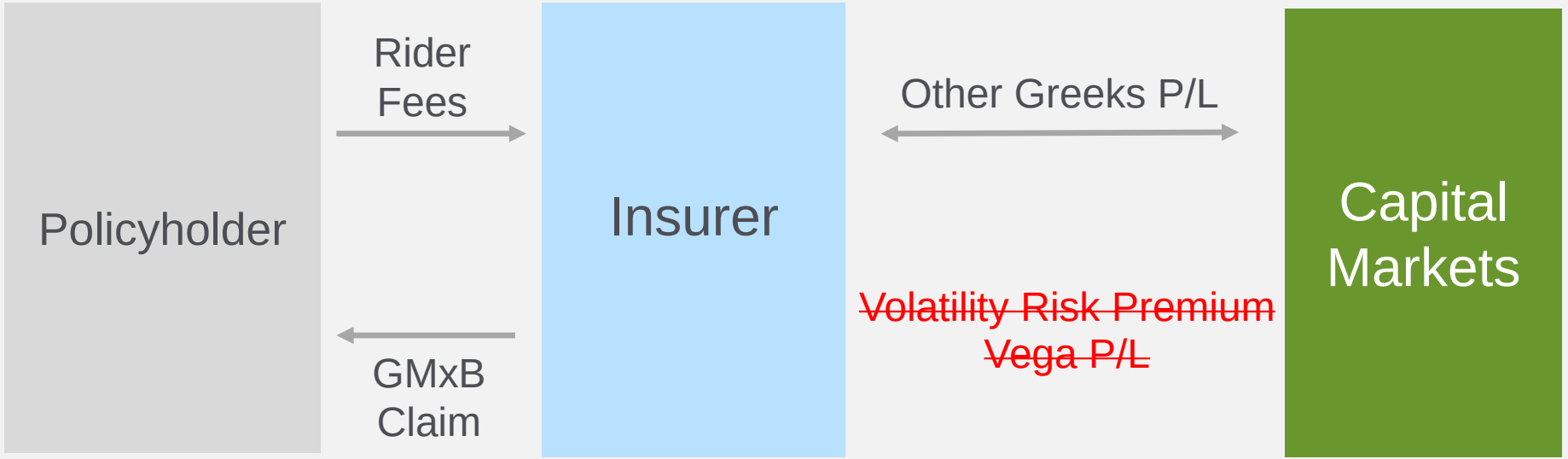
	Hedging	Reinsurance	Accounting
Retain Volatility Risk			
Mitigate Volatility Risk			

Volatility Retention in Hedge Program Framework



Volatility Retention in Hedge Program Framework



Retain Volatility Risk – Reinsurance

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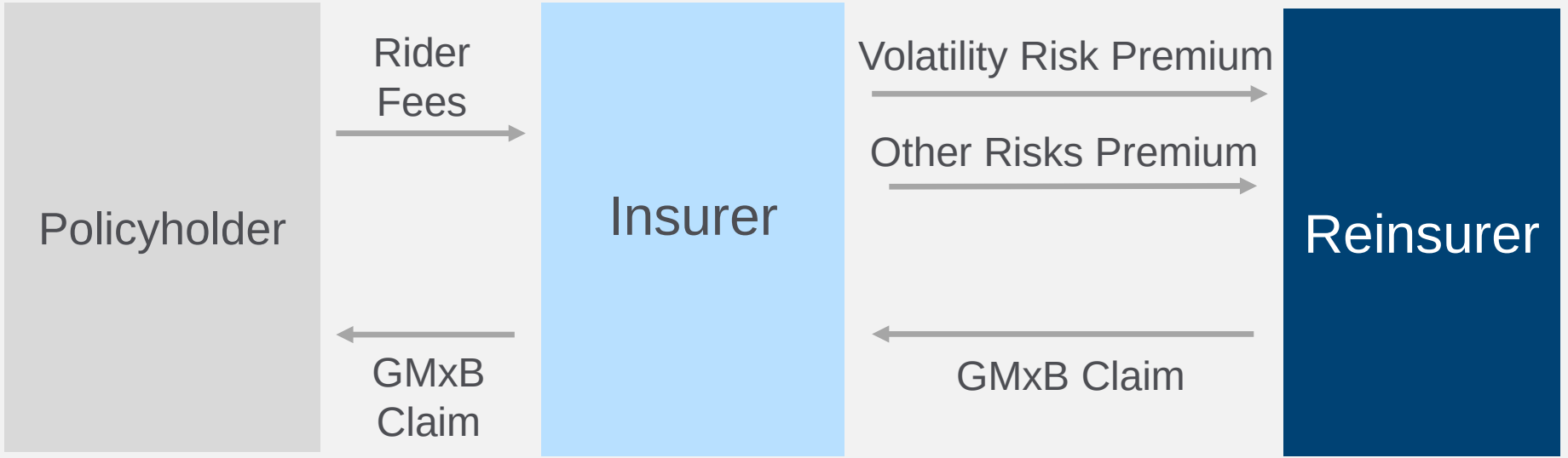
	Hedging	Reinsurance	Accounting
Retain Volatility Risk			
Mitigate Volatility Risk			

Volatility Retention in Reinsurance Framework



Volatility Retention in Reinsurance Framework

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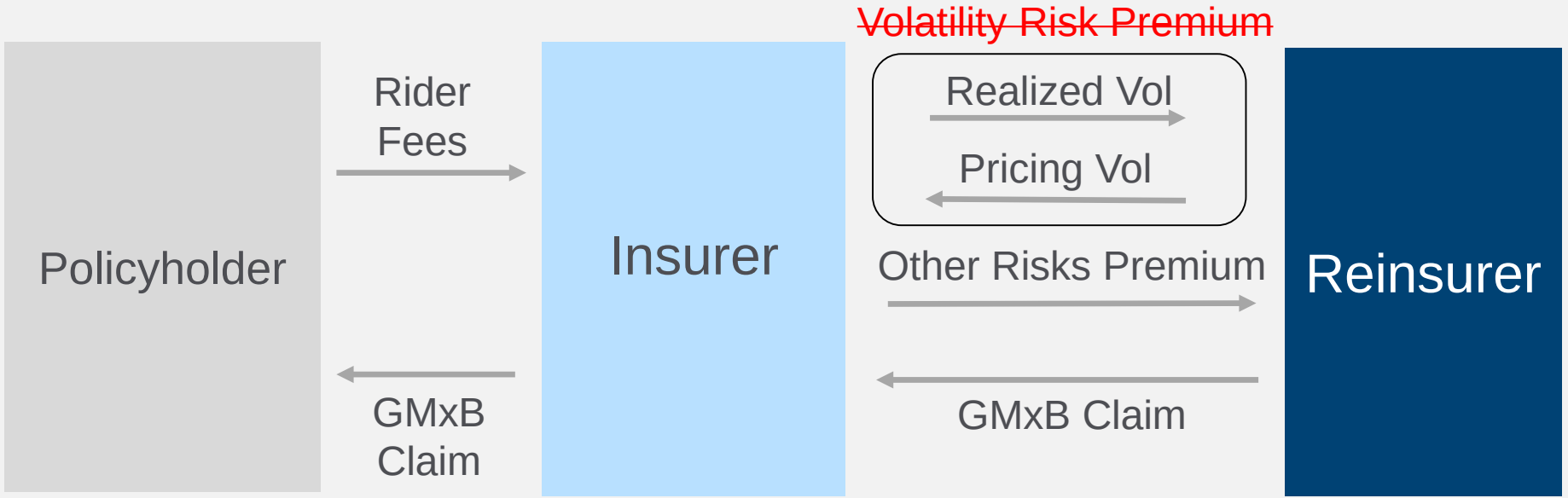

- Reinsurance cost based on Pricing Vol selected by Insurer
- Reduced Cost of Reinsurance but Exposure to Realized Vol via an Experience Adjustment
- Additional Technical Details in Appendix

Retain Volatility Risk – Accounting

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	Hedging	Reinsurance	Accounting
Retain Volatility Risk			
Mitigate Volatility Risk			

Retain Volatility Risk – Impact on GAAP Income Statement

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- US GAAP Long-Duration Targeted Improvements – Effective 1/1/22
- VA / FIA guarantees will be marked to market
- Requires a “market consistent” valuation
- Retention of Volatility Risk will result in an increase in GAAP earnings volatility

Retain Volatility Risk – Impact on Statutory Reserve (VM-21)

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Stochastic Reserve = (1 – E) x CTE70 (“Best Efforts”) +
E x CTE70 (“Adjusted”)

- “E” is error term – minimum of 5%
- May be difficult to justify low “E” while fully retaining volatility risk
- “Best Efforts” includes future planned risk mitigation (hedging / reinsurance)
- “Adjusted” considers only hedge instruments / reinsurance currently in place
  - May be significantly higher than “Best Efforts”, driving up total Stat Reserve
- VM-21 stochastic reserve uses VM-20 ESG which varies volatility

Retain Volatility Risk – Impact on P/L Distribution

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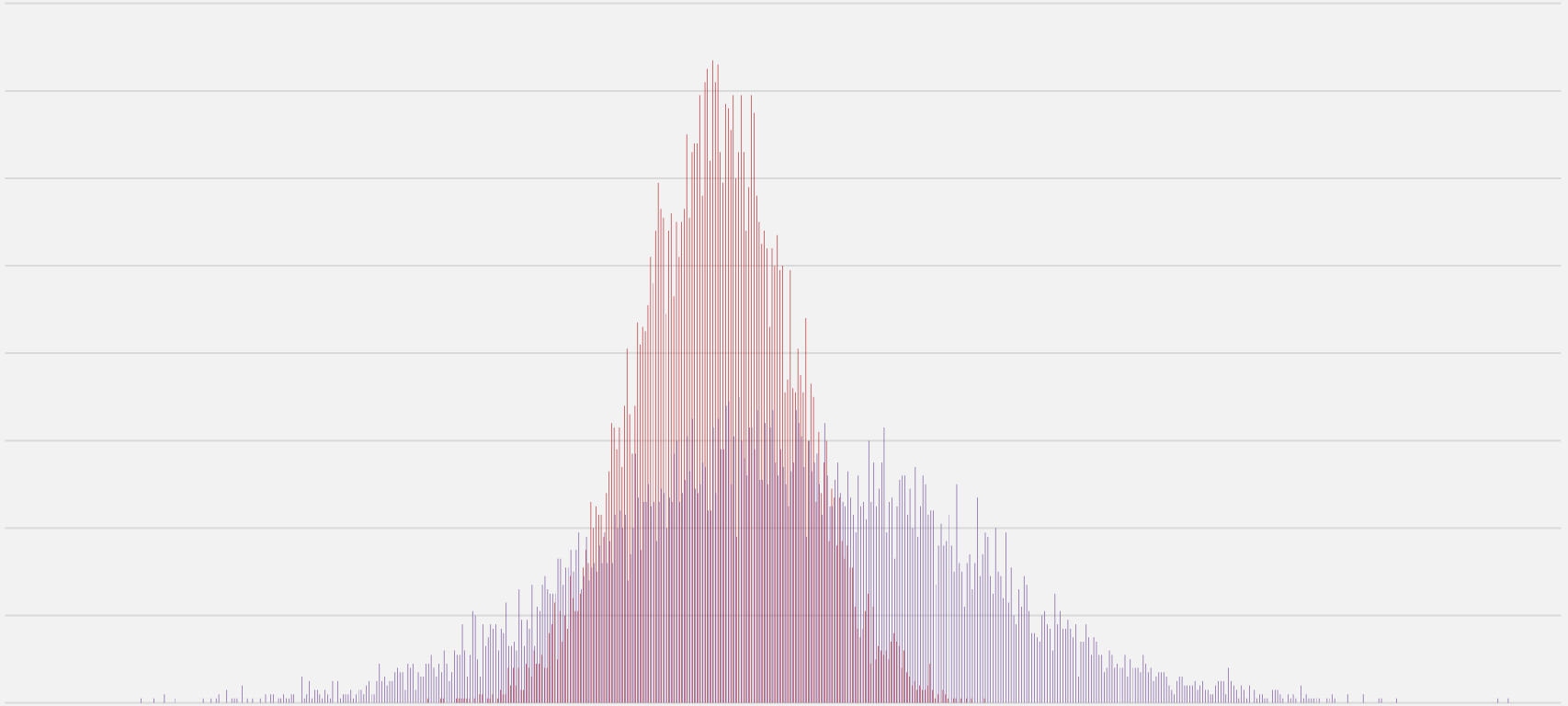

2 Mitigate Volatility Risk

Better beware, be canny and careful…

Mitigate Volatility Risk

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	Hedging	Reinsurance	Accounting
Retain Volatility Risk			
Mitigate Volatility Risk			

Mitigate Volatility Risk – Potential Reasoning

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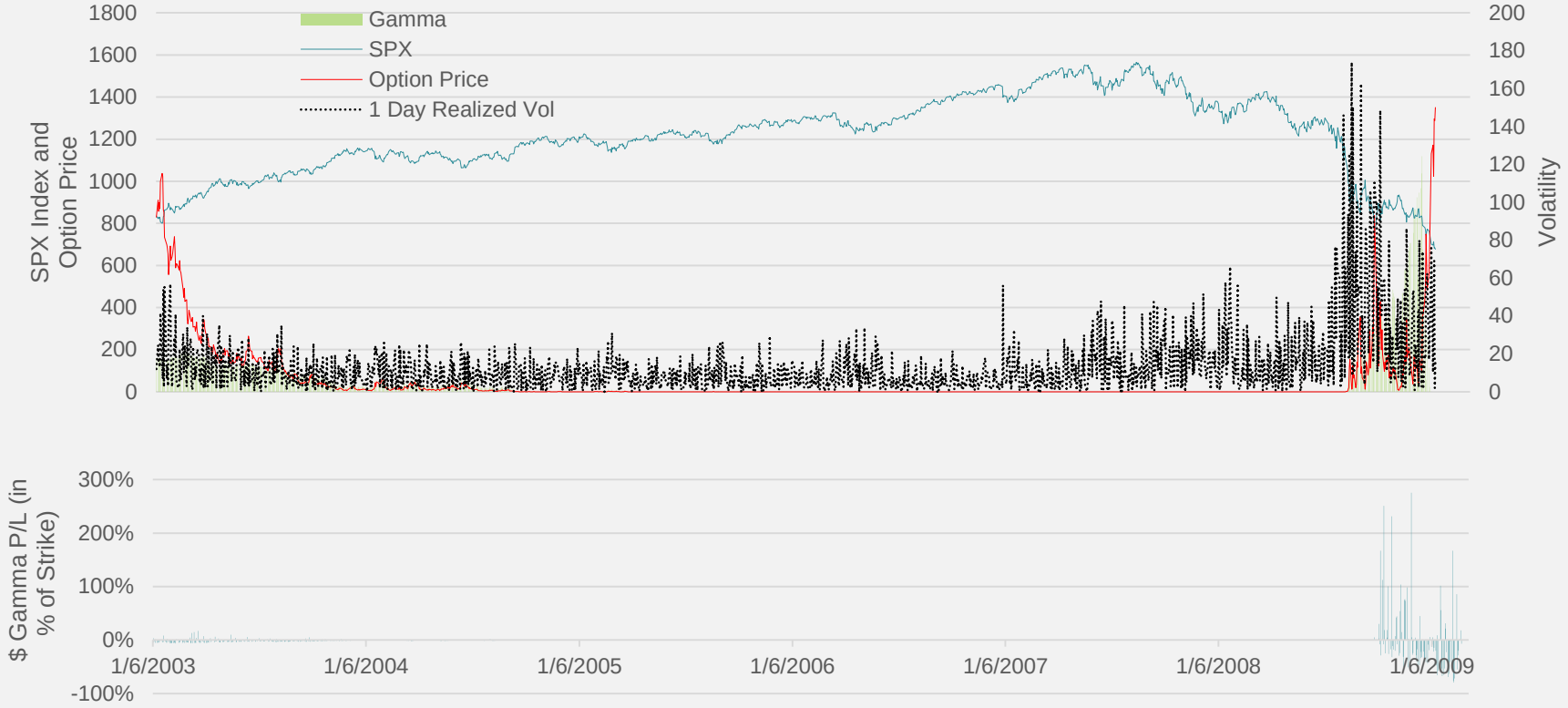
- Significant P/L impact when Increased Realized Volatility occurs simultaneously with Increased Gamma Exposure
- Reduce GAAP Income Statement Volatility
- Reduction in Reserves / Capital

Essentially: The opposite of reasons to retain the risk from the previous section

Mitigate Volatility Risk – Avoid Perfect Storm Scenario of Both High Realized Volatility and High Gamma



Mitigate Volatility Risk – Hedging

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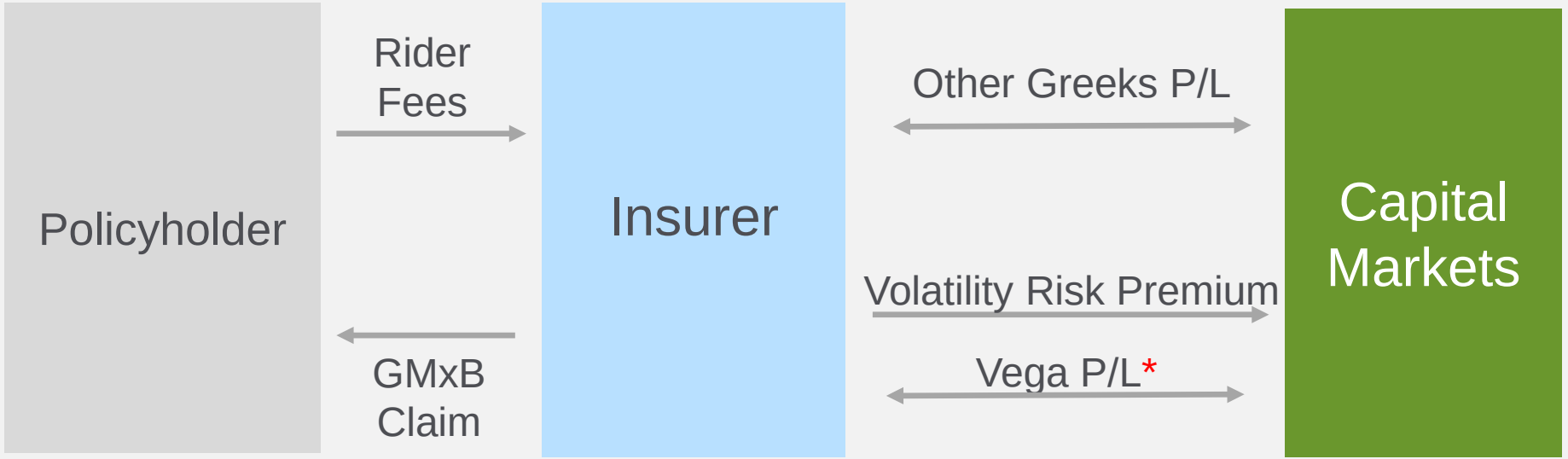
	Hedging	Reinsurance	Accounting
Retain Volatility Risk			
Mitigate Volatility Risk			

Volatility Mitigation in Hedge Program Framework



* Vega protection limited by low / no supply at later durations

Mitigate Volatility Risk – Reinsurance

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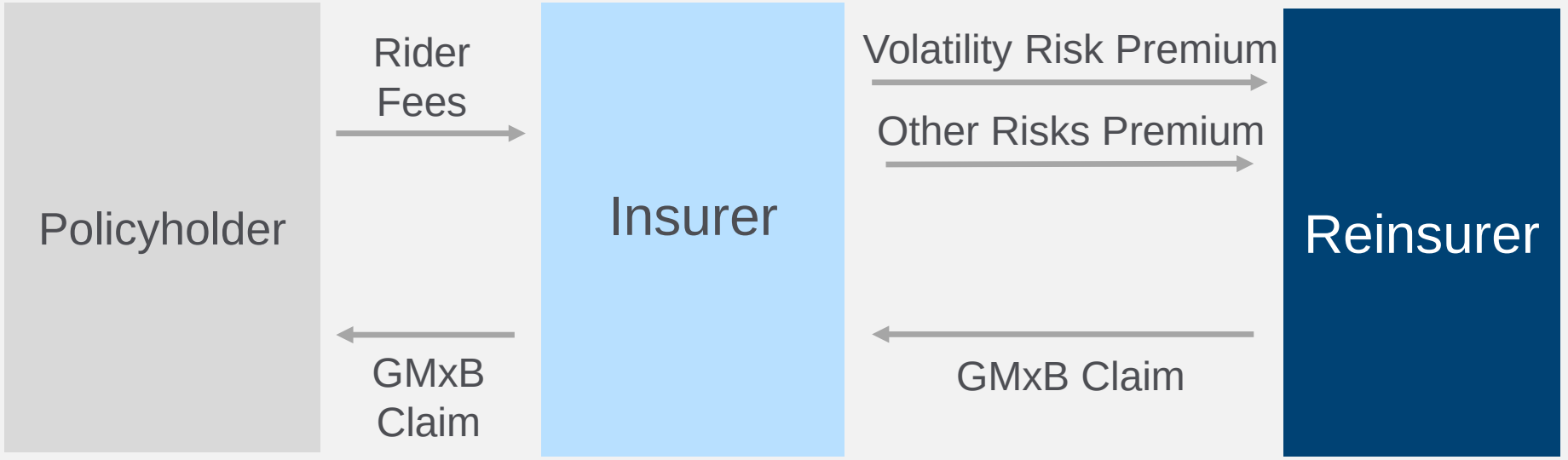
	Hedging	Reinsurance	Accounting
Retain Volatility Risk			
Mitigate Volatility Risk			

Volatility Mitigation in a Reinsurance Framework



No limitation on Vega protection – reinsurer can assume risk for entire product term

Mitigate Volatility Risk – Accounting

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	Hedging	Reinsurance	Accounting
Retain Volatility Risk			
Mitigate Volatility Risk			

Mitigate Volatility Risk – Accounting

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- Reduction in GAAP Income Statement Volatility
  - May be limited in hedge program due to low / no supply at later durations
- Statutory Reserve under VM-21 should achieve a lower “E” term
  - Might be as low as 5% for hedging program
  - Might effectively be Zero for Reinsurance program, since “Best Efforts” should be equal to “Adjusted” in that case (subject to regulatory approval)
- Narrowing of potential P/L outcomes

3 Hybrid Solution For Volatility Risk

Climb Every Mountain, Ford Every Stream…

Hybrid Solution

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- We have developed and analyzed a hybrid Vega Risk Management solution
- Proposed solution:
  - Achieves protection against short-term changes in Volatility
  - Reduces cost (versus full risk transfer) by retaining Volatility risk at longer durations
  - Takes advantage of historical experience that Realized Volatility < Implied Volatility

Hybrid Solution – Volatility Risk Premium

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Insurer Risk Management	Volatility Risk Premium	Residual Volatility Risk
Retain Full Vol Risk	None	High
Mitigate Short-Dated Vol Risk on a Periodic Rolling Basis	Medium	Medium
Mitigate Full Vol Risk	High	Low (Hedge) None (Reinsure)

Hybrid Solution – Higher Cost of Full Volatility Risk Transfer Caused by Uncertainty in Both **Notional** and **Price** of Volatility Protection

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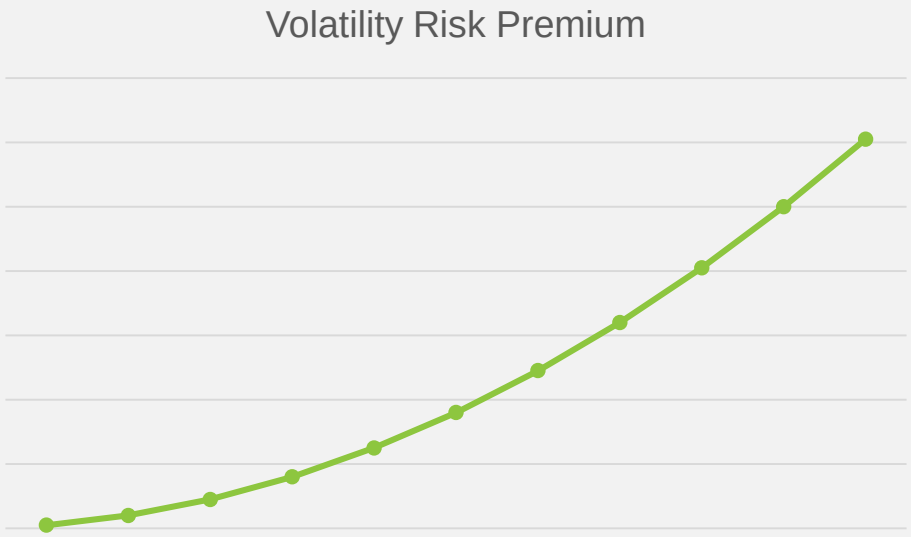
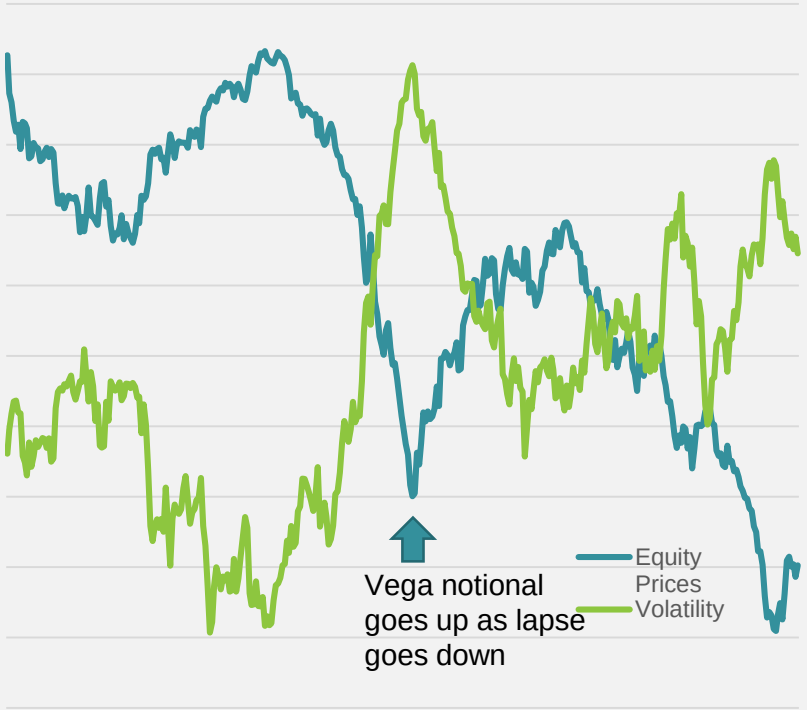
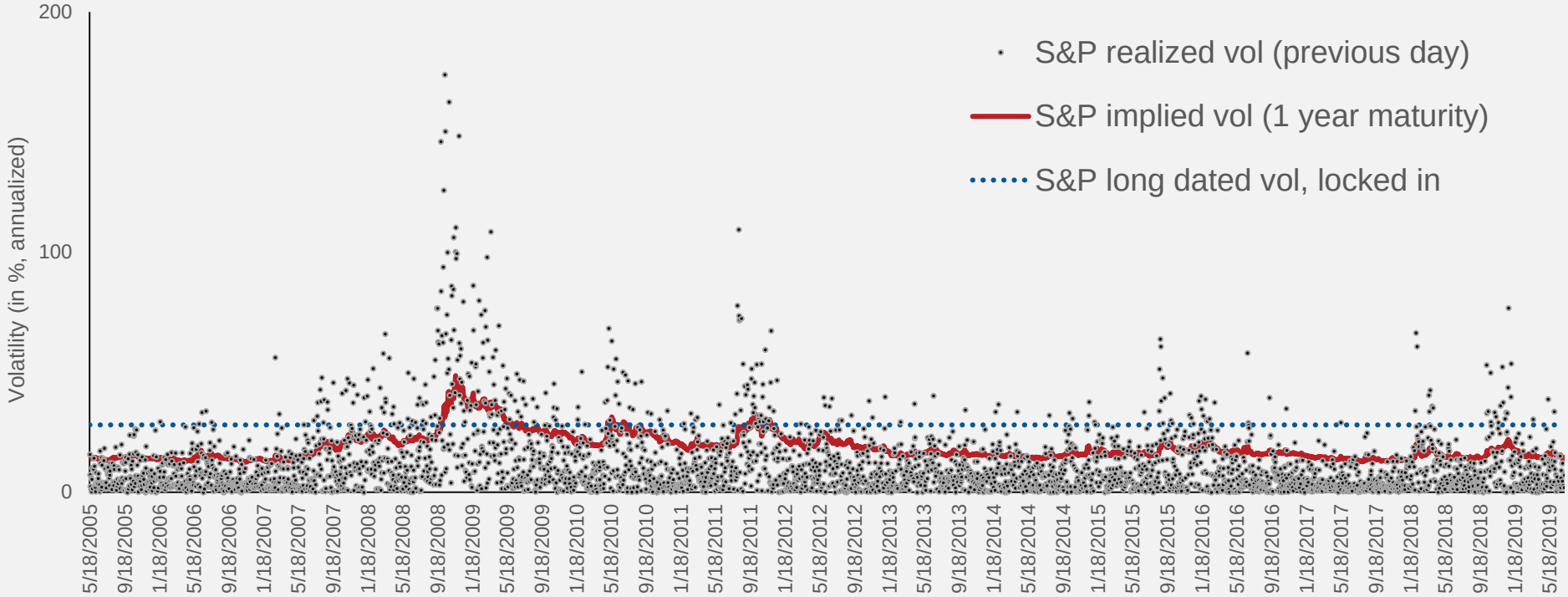


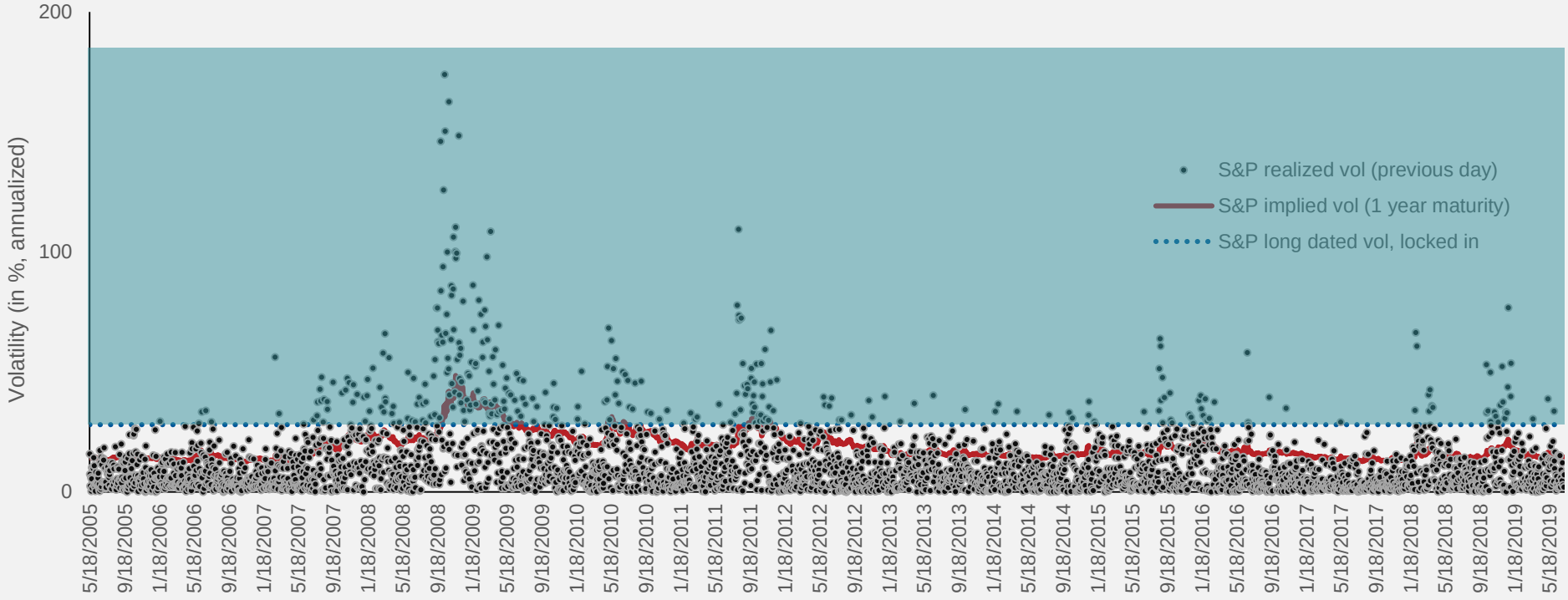


Hybrid Solution – Determining How Much Volatility Risk to Retain / Mitigate



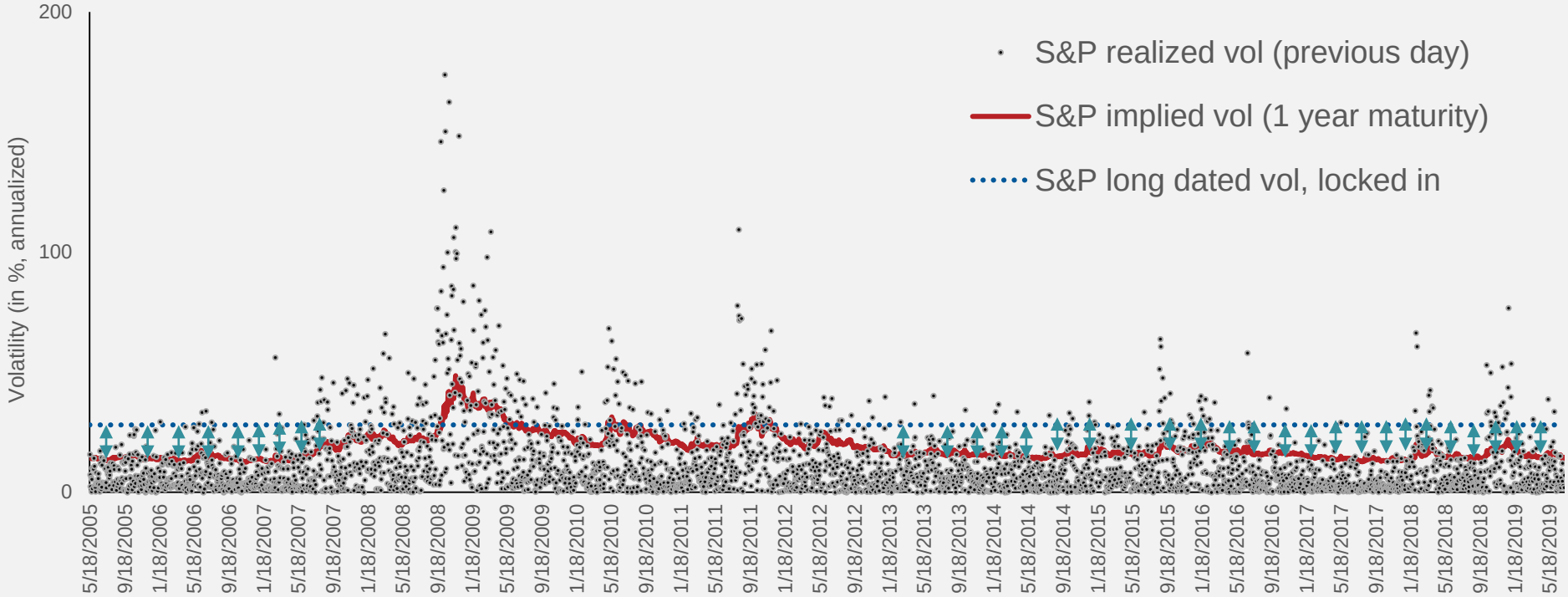
(Source: Bloomberg)

Hybrid Solution – Volatility Risk Can Be Costly, Especially when Gamma is High



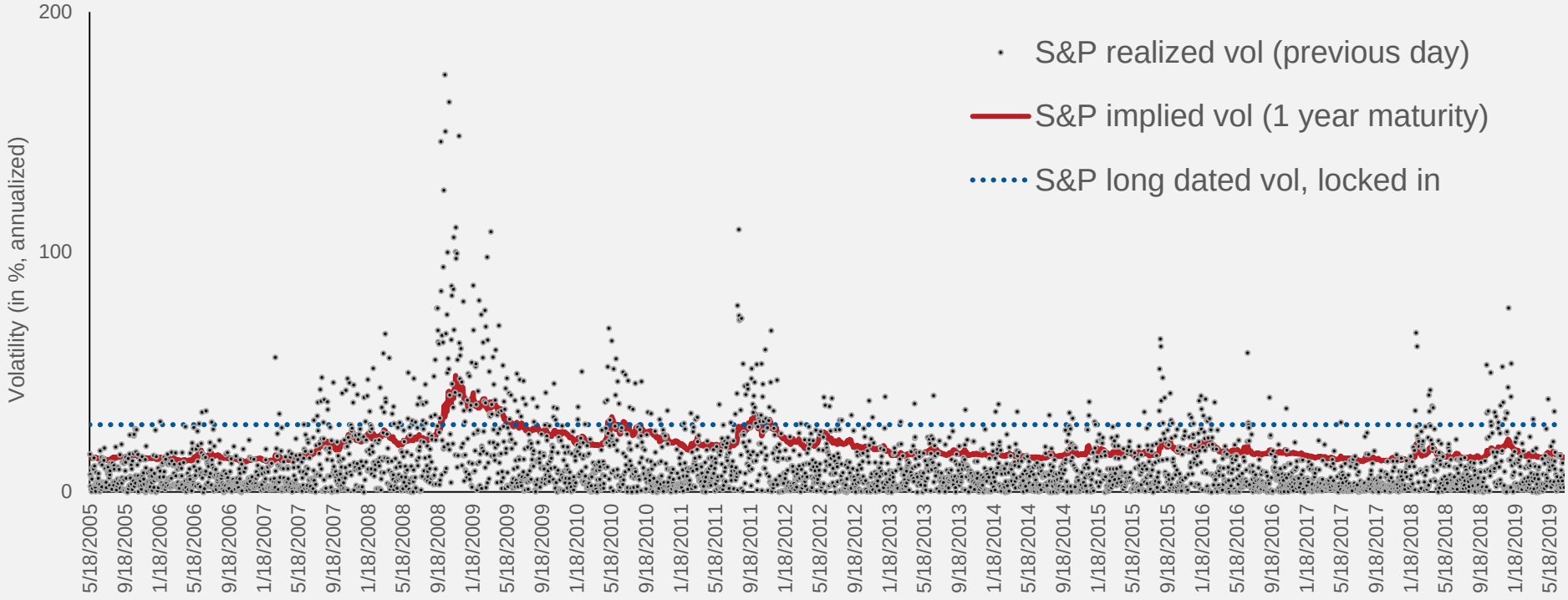
(Source: Bloomberg)

Hybrid Solution – Paying to Lay Off Long-Dated Volatility Risk May Be Sub-Optimal



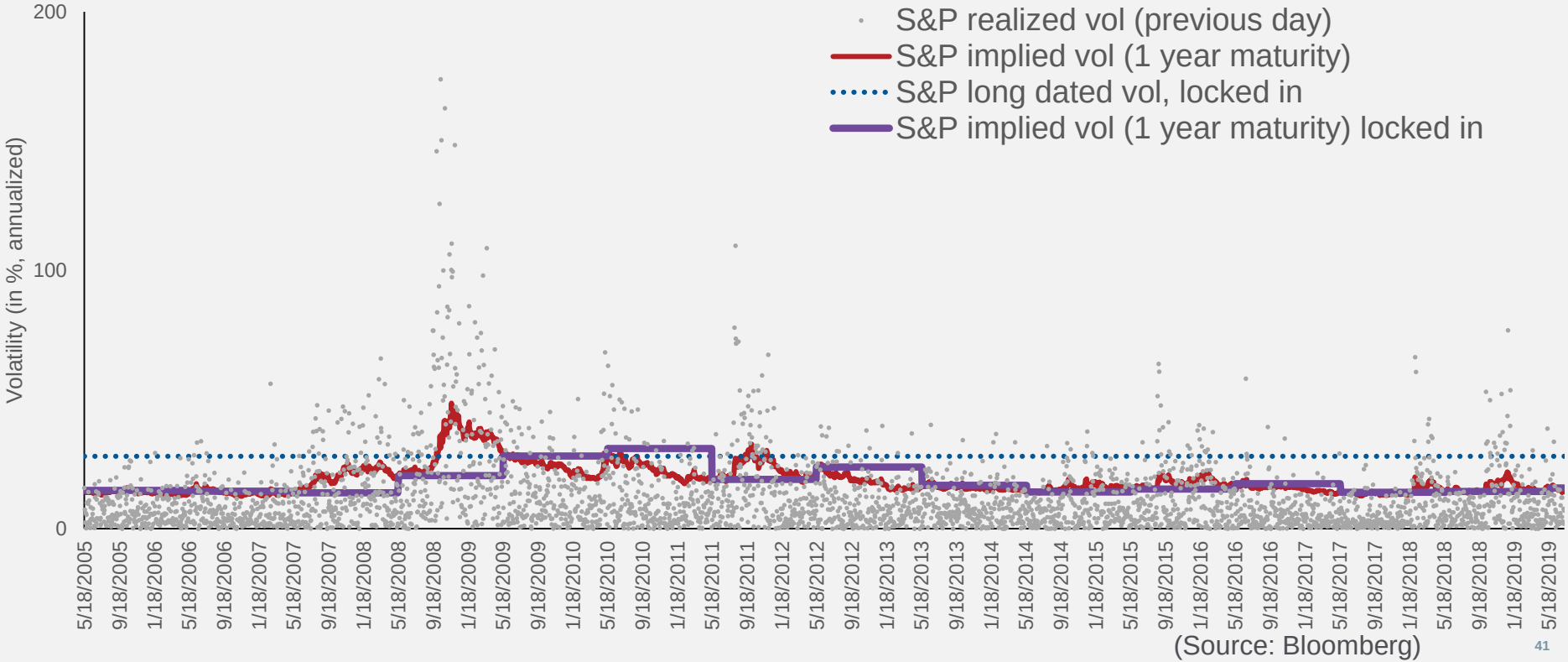
(Source: Bloomberg)

Hybrid Solution – Focus on Shorter-Dated and More Liquid Volatility Durations May Be Preferable in Terms of Risk / Reward



(Source: Bloomberg)

Hybrid Solution – Renewing Coverage of Implied Volatility on a 1-year Periodic Basis



(Source: Bloomberg)

Hybrid Solution – Volatility True-Up on Realized versus Implied

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1. Reinsurance Solution with Insurer retaining **full** Volatility Risk

$$VolatilityAdjustmentRealizedAmount(t) = \frac{1}{2} \cdot \sum_{i=1}^{n} \Gamma_{\$}(t_i) \cdot \left(\sigma^2_{real}(t_i) - \sigma^2_{pricing}\right) \cdot dt(i-1, i)$$

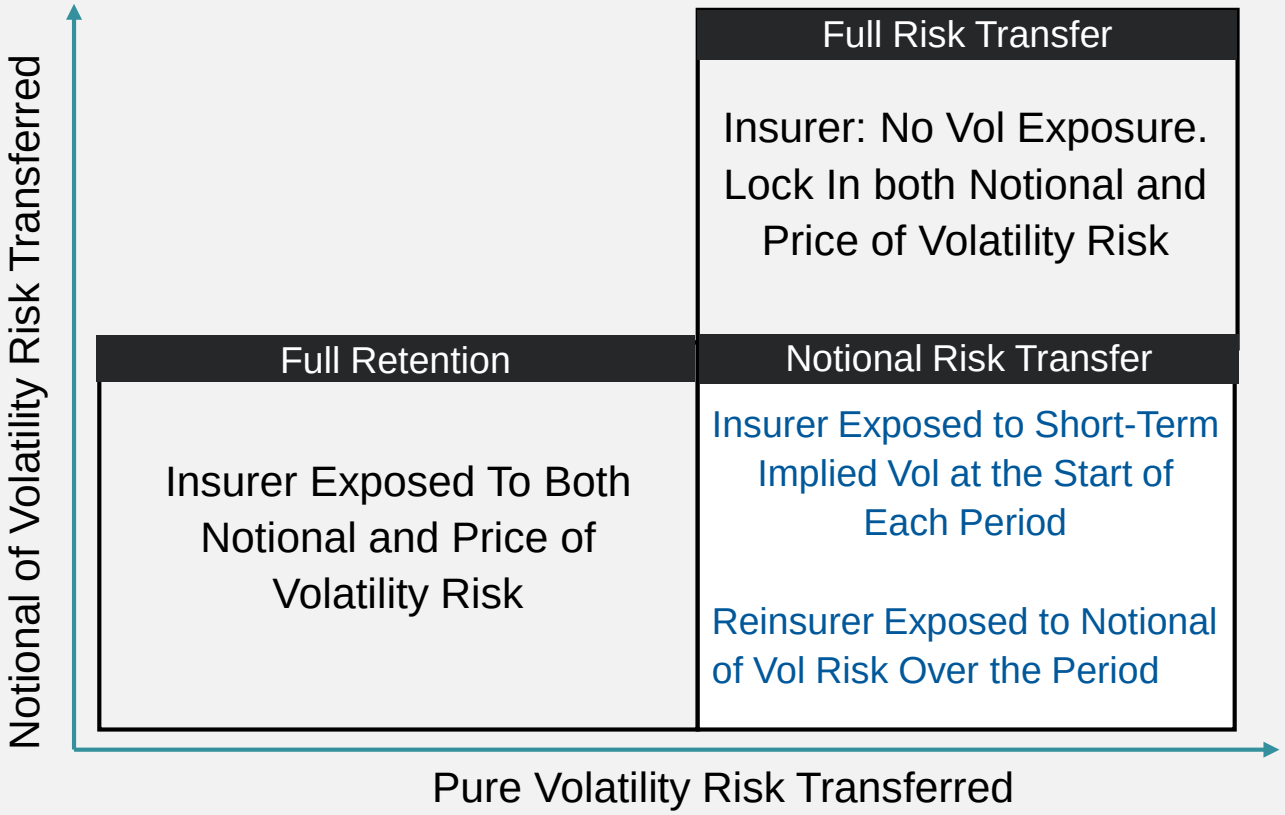
2. Hybrid Solution – Volatility True-Up On Implied

Settled at the beginning of each period. Sharing of volatility risk via decomposition of volatility exposure into **notional** and **pure** volatility :

"Expected gamma" over the period, provided by MR at the start of the period

$$VolatilityAdjustmentImpliedAmount(t) = \frac{1}{2} \cdot \overline{\Gamma_{\$}}(t_0) \cdot \left(\sigma^2_{implied}(t_0) - \sigma^2_{pricing}\right)t$$

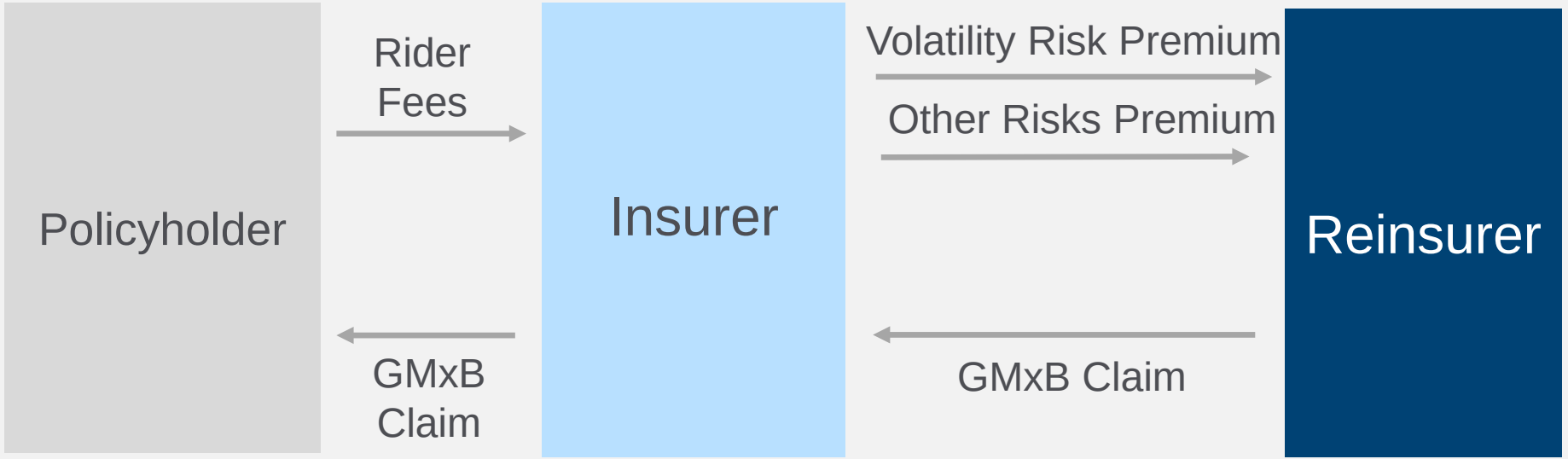
Hybrid Solution – Reduces Cost Outlay but Provides Significant Volatility Risk Mitigation



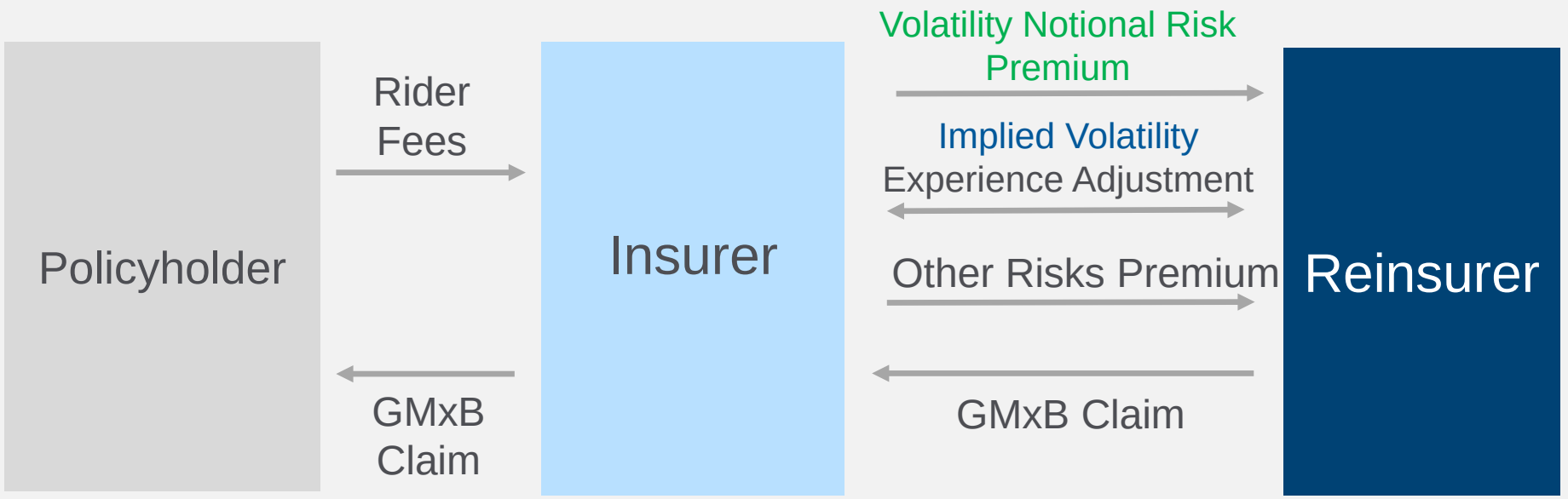
Simplified volatility exposure allows the insurer to reduce cost and benefit from the liquid options market

By locking in notional at the start of each period, reinsurer has the gamma fluctuation risk

Reminder – Full Volatility Risk Transfer via Reinsurance

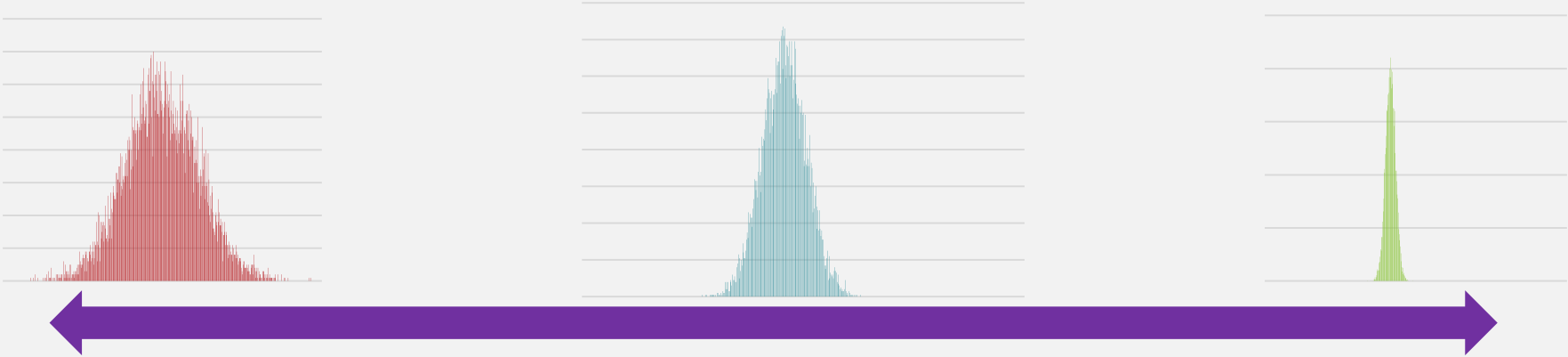


Hybrid Solution – Partial Volatility Risk Transfer via Reinsurance



- Hybrid Solution splits volatility risk into Notional Risk and Pure Volatility Cost
- Cost is reduced, but insurer retains a portion of volatility risk

Volatility Exposure: Locking in Implied Vol



Volatility Risk Retained

Exposure: $\sigma^2_{real}(t_i)$

Hybrid Solution

Exposure:
$\sigma^2_{1\mathrm{Y}\ implied}(t_i)$, reset every year.

Liquid options market

Volatility Risk Mitigated

Exposure:
$\sigma^2_{long\ dated\ implied}(t_i)$, set up front.

Illiquid options market

A Appendix: Volatility True-Up Mechanism for Reinsurance

Oh…I don’t know…High on the Hill was a Lonely Goatherd?

Option Writer Has Gamma P/L Loss when Realized Volatility > Implied Volatility

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$$dV = \frac{\partial V}{\partial t}dt + \frac{\partial V}{\partial S_t}dS_t + \frac{1}{2}\frac{\partial^2 V}{\partial S_t^2}(dS_t)^2$$

$$= \left(\theta_t + \frac{1}{2}\sigma_{t,real}^2 S_t^2 \Gamma_t\right)dt + \Delta_t dS_t$$

$$= \underbrace{r_t(V - \Delta_t S_t)dt + \Delta_t dS_t}_{Delta\ P\&L\ Loss\ (t,t+dt)} + \underbrace{\frac{1}{2}S_t^2\Gamma_t \cdot \left(\left(\sigma_{t,real}^S\right)^2 - \left(\sigma_{implied}^S\right)^2\right)dt}_{Gamma\ P\&L\ Loss(t,t+dt)}$$

From Black Scholes: "Theta ~ Gamma"

$$\boldsymbol{\theta_t + \frac{1}{2}\left(\sigma_{implied}^S\right)^2 S_t^2 \Gamma_t} + r_t S_t \Delta_t - r_t V = 0$$

Volatility True-Up on Realized versus Implied

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- Reinsurance is priced at an off-market “pricing” volatility level, thus reducing the cost
- A “Volatility Experience Adjustment” payment is made at the end of each period:

$$\frac{1}{2} \cdot \sum_{i=1}^{n} \Gamma_{\$}(t_i) \cdot \left(\sigma^2_{real}(t_i) - \sigma^2_{pricing}\right) \cdot dt(i-1, i)$$

- Realized volatility is measured periodically
- Volatility Experience Adjustment calculated based on differential between realized and “pricing” volatility in a period
  - Can be paid from insurer to reinsurer or vice versa
- Similar to common “Volatility Risk Premium” investment strategies, but in a reinsurance context

GLWB Reinsurance Cost Index

My Favorite Things…

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GLWB Reinsurance Cost Index
Risk Classifications of Typical GLWB Inforce Block

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- Biometric risk
  - Mortality risk, longevity risk pre-claim, longevity risk post-claim
- Policyholder Behavior risk
  - Withdrawal timing, Withdrawal utilization (as % of maximum), Lapse
- Financial Market risk
  - Hedgable – Equity, Interest Rates, Short-Duration Volatility
  - Non-Hedgable – Fund Basis, Long-Duration Volatility, Liquidity, Correlations (equity / interest rate, e.g.)
- Cross risks
  - Financial market / Behavior, e.g.

GLWB Reinsurance Cost Index
Population / Product Design / Key Assumptions

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Population

- Age Distribution
- Male / Female
- Qualified / Non-qualified
- Fund Allocation
- ITM / OTM Distribution

Product Design

- Surrender Charges
- Fees – Base / Rider
- Guarantee
  - Roll-up / Ratchet
  - Maximum Withdrawal %

Key Assumptions

- Withdrawal Timing
- Withdrawal Utilization %
- Lapse
- Mortality

GLWB Reinsurance Cost Index
Withdrawal Methodology

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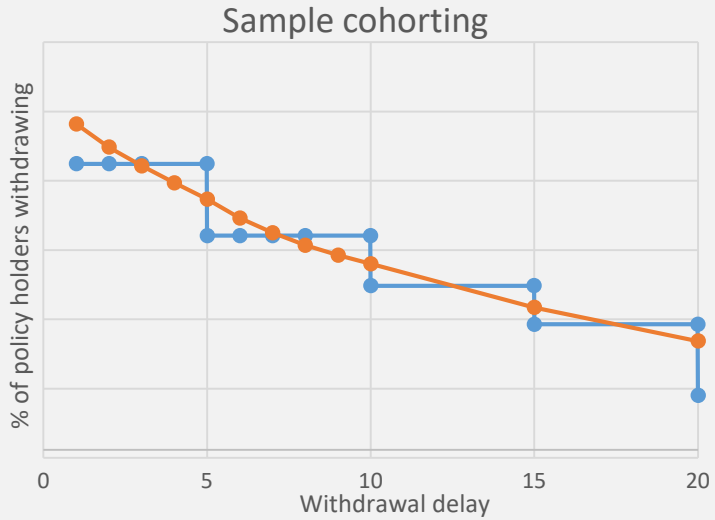
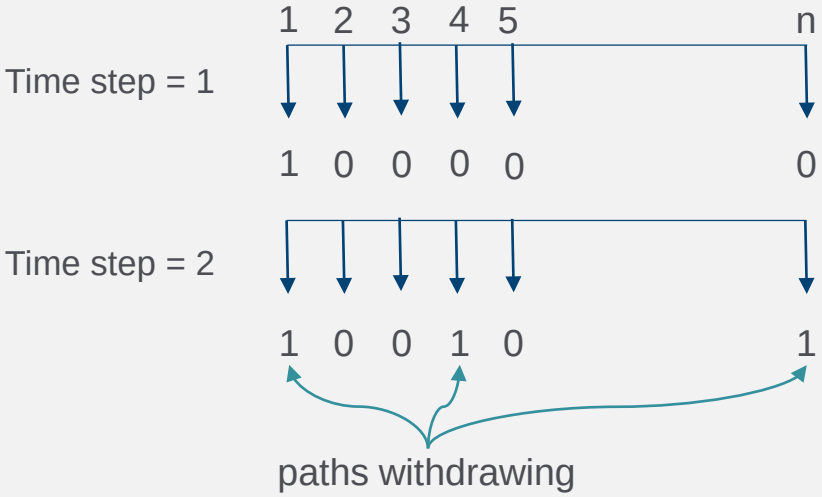
Cohorting methodology

Munich Re has used the common withdrawal cohorting approach by splitting each policy into multiple sub-policies, with different withdrawal delays



Binary methodology

Munich Re also uses binary withdrawal methodology for valuing certain inforce blocks and for new product development



GLWB Reinsurance Cost Index
Reinsurance Structure

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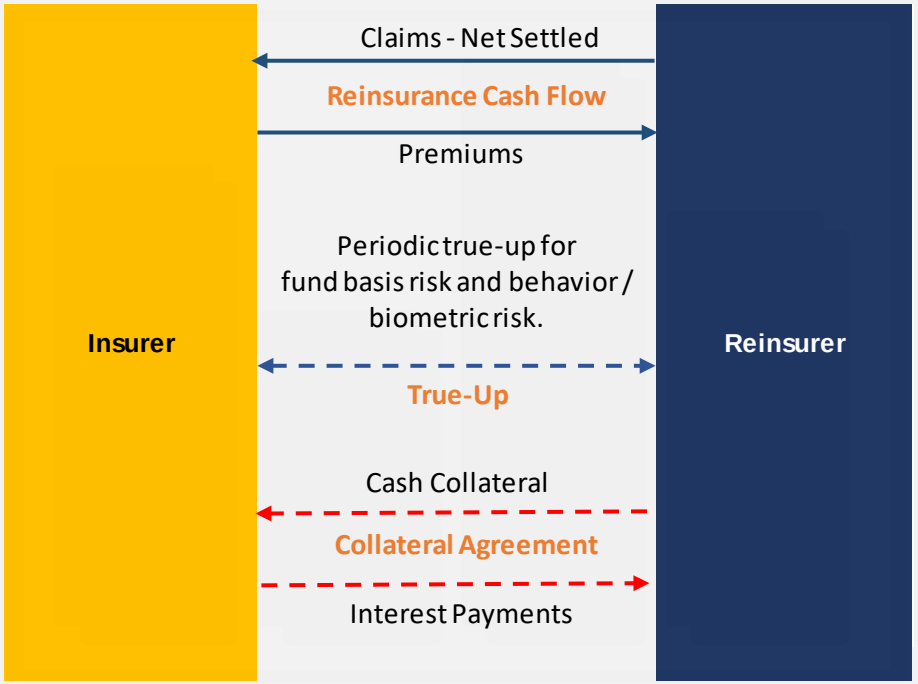
- Reinsurance Cash Flow
  - Insurer pays reinsurance premiums
  - Reinsurance Claims are “net settled” – paid as a lump sum when policy account value = 0.
- True-Up
  - Depends on specific reinsurance structure
  - Will include the impact of realized experience differences from expected on any retained risks (behavior, mortality, basis, etc.)
- Collateral Agreement
  - Reinsurer posts the full market-consistent value of the reinsurance contract **in cash** to the Insurer
  - Insurer credits the collateral at an agreed rate



GLWB Reinsurance Cost Index

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Cost Drivers - Examples	Direction	Cost
RI collateral crediting rate	↑	↓
Pricing volatility	↑	↑
RI claim calculation interest rate	↑	↓
RI claim calculation mortality rate	↑	↓
RI claim calculation mortality improvement	↑	↑
Lapse assumption (all else equal)	↑	↓
Guarantee utilization	↑	↑
Claim cap level	↑	↑
Claim deductible level	↑	↓

GLWB Reinsurance Cost Index

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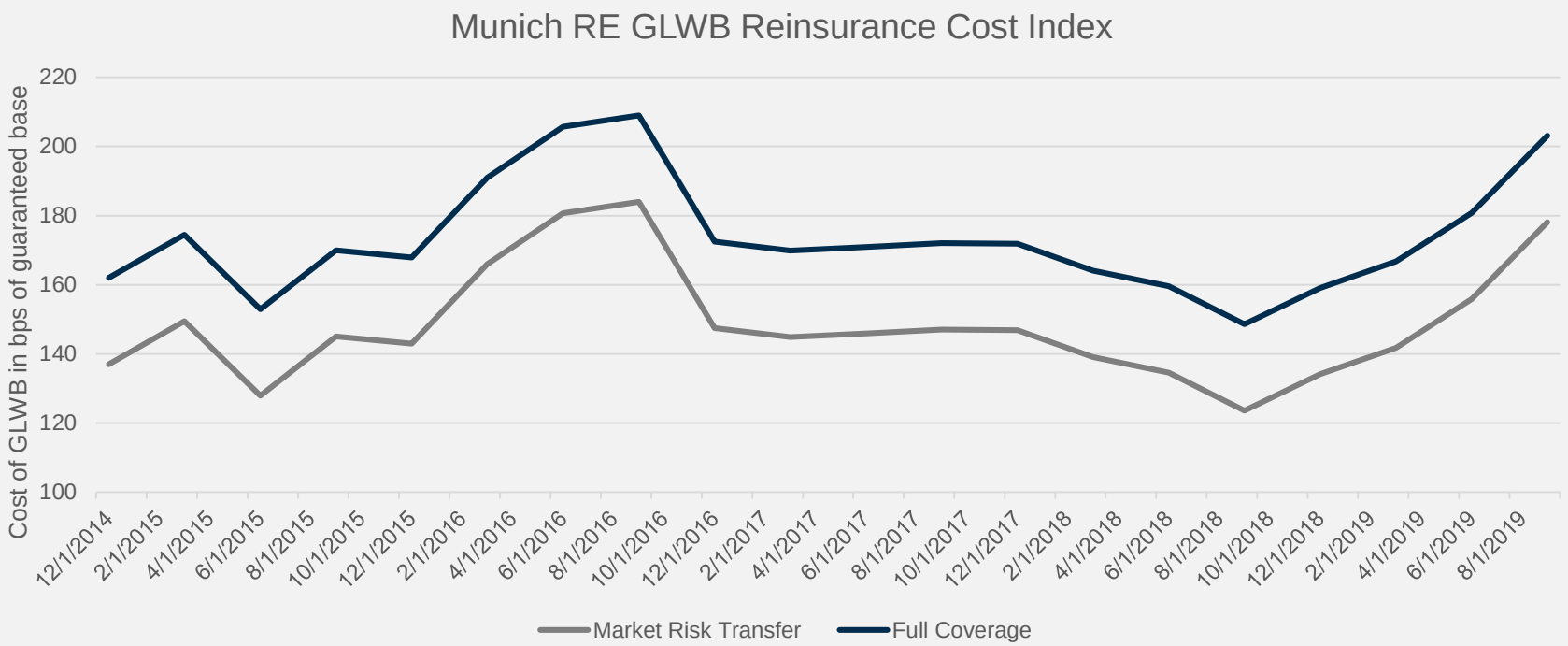

GLWB Reinsurance Cost Index

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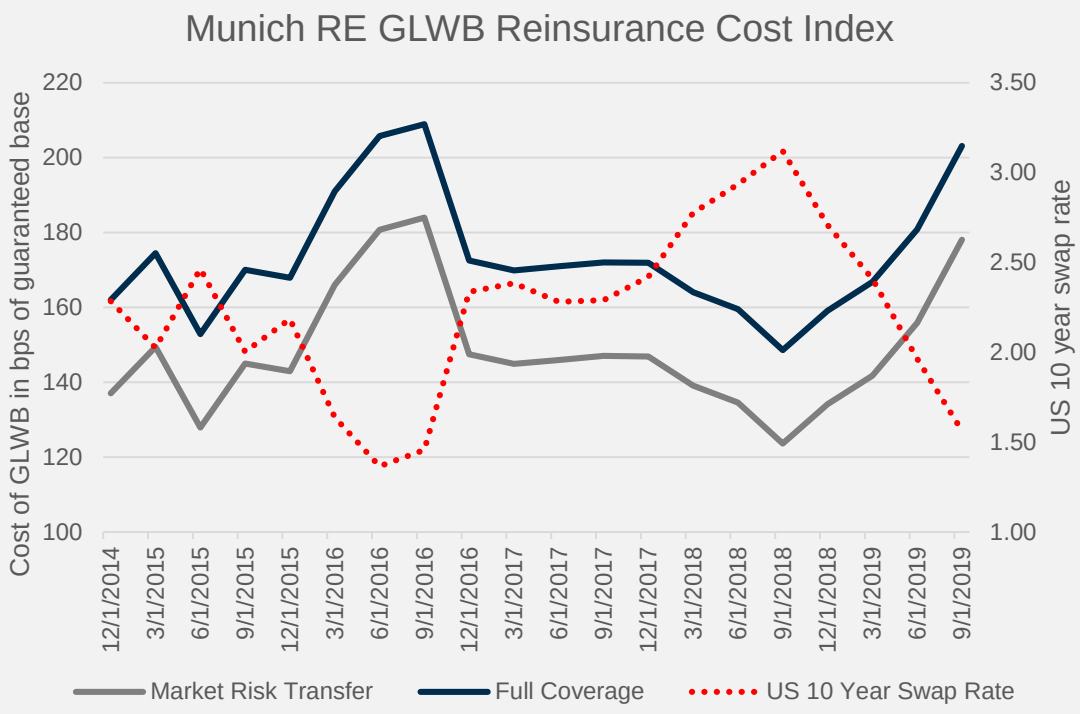

Market Risk Transfer

- Designed to be similar to a hedge program
- Covers equity / rate / vol risk

Full Coverage

- Includes all significant risks – mortality, behavior, market, etc.
- Reinsurance Claim paid as “lump sum” so post-claim longevity is excluded

All-In Reinsurance Cost

- Includes Cost of Capital and Liquidity, Expense, Profit, etc.

Our New York Team

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So Long…
Farewell…
Auf Wiedersehen…
Adieu…